PLANT ITEM MATERIAL SELECTION DATA SHEET

TLP-COND-00001 (PTF)
Treated LAW Evaporator Primary Condenser

- Design Temperature (°F): 250/49
- Design Pressure (psig) (Max/min): Shell side: 50/FV; Tube side: 100/FV
- Location: outcell

Contents of this document are Dangerous Waste Permit affecting

Operating conditions are as stated on sheet 5

Options Considered:

- Stream to condenser is pH ≈7, temperature 122 °F to 250 °F

Materials Considered:

Material (UNS No.)	Relative Cost	Acceptable Material	Unacceptable Material
Carbon Steel	0.23		X
304L (S30403)	1.00	X	
316L (S31603)	1.18	X	
6% Mo (N08367/N08926)	7.64	X	
Alloy 22 (N06022)	11.4	X	
Ti-2 (R50400)	10.1		X

Recommended Material: 316 (max 0.030% C; dual certified)

Recommended Corrosion Allowance: Shell side: 0.04 inch; Tube side: N/A

Process & Operations Limitations:

- None

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3/24/04
EXPIRES: 12/07/05

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This bound document contains a total of 5 sheets.

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Corrosion Considerations:

a General Corrosion
Uniform corrosion is not a concern at the normal operating conditions. 304L would be suitable.

In 2N nitric acid cleaning, the corrosion rates are low. The amounts of halides and solids are also small so there is little concern about excessive uniform attack.

Conclusion:
At temperatures less than 140°F, either 304L or 316L is expected to be sufficiently resistant to the waste solution with a probable general corrosion rate of less than 1 mpy.

b Pitting Corrosion
At the expected normal operating conditions, 304L is expected to be acceptable. Because of the high design temperature, 316L is recommended.

Conclusion:
Based on the expected operating conditions the vessel 304L stainless steel is satisfactory, but 316L is recommended to provide additional pitting resistance should chlorides concentrate.

c End Grain Corrosion
End grain corrosion only occurs in metal with exposed end grains and in highly oxidizing acid conditions.

Conclusion:
Not applicable to this system.

d Stress Corrosion Cracking
The exact amount of chloride required to cause stress corrosion cracking is unknown. In part this is because the amount varies with temperature, metal sensitization, and the environment. But it is also unknown because chloride tends to concentrate under heat transfer conditions, by evaporation, and electrochemically during a corrosion process. Hence, even as little as 10 ppm can lead to cracking under some conditions. Generally, as seen in Sedriks (1996) and Davis (1987), stress corrosion cracking does not usually occur below about 140°F.

Conclusion:
Because of the normal operating environment as well as that which can occur during off normal conditions, the minimum alloy recommended is 316L stainless steel.

e Crevice Corrosion
The pitting discussion covers this area.

Conclusion:
See Pitting.

f Corrosion at Welds
Corrosion at welds is not considered a problem in the proposed environment.

Conclusion:
Weld corrosion is not considered a problem for this system.

g Microbiologically Induced Corrosion (MIC)
The proposed operating conditions on the process side are acceptable for microbe growth. The use of treated process water makes infection unlikely.

Conclusion:
MIC is not considered a concern.

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h Fatigue/Corrosion Fatigue
Corrosion fatigue is not expected to be a concern.

Conclusions
Not believed to be a concern.

i Vapor Phase Corrosion
The vapor phase portion of the shell will be continually washed with condensing vapors.

Conclusion:
No vapor phase corrosion is anticipated.

j Erosion
Velocities within the condenser are expected to be low.

Conclusion:
Not a concern.

k Galling of Moving Surfaces
Not applicable.

Conclusion:
Not applicable.

l Fretting/Wear
Not expected to be a concern.

Conclusion:
Not a concern.

m Galvanic Corrosion
For the environment and the proposed alloys, there is not believed to be a concern.

Conclusion:
Not a concern.

n Cavitation
None expected.

Conclusion:
Not believed to be of concern.

o Creep
The temperatures are too low to be a concern.

Conclusion:
Not applicable.

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References:

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2. Sedriks, AJ, 1996, *Corrosion of Stainless Steels*, John Wiley & Sons, Inc , New York, NY 10158

Bibliography:

1. Agarwal, DC, *Nickel and Nickel alloys*, In. Revie, WW, 2000 *Uhlig's Corrosion Handbook*, 2nd Edition, Wiley-Interscience, New York, NY 10158
2. Danielson, MJ & SG Pitman, 2000, *Corrosion Tests of 316L and Hastelloy C-22 in Simulated Tank Waste Solutions*, PNWD-3015 (BNFL-RPT-019, Rev 0), Pacific Northwest Laboratory, Richland WA
3. Davis, JR (Ed), 1994, *Stainless Steels*, In ASM Metals Handbook, ASM International, Metals Park, OH 44073
4. Hamner, NE, 1981, *Corrosion Data Survey*, Metals Section, 5th Ed, NACE International, Houston, TX
5. Jones, RH (Ed.), 1992, *Stress-Corrosion Cracking*, ASM International, Metals Park, OH 44073
6. Koch, GH, 1995, *Localized Corrosion in Halides Other Than Chlorides*, MTI Pub No. 41, Materials Technology Institute of the Chemical Process Industries, Inc, St Louis, MO 63141
7. Phull, BS, WL Mathay, & RW Ross, 2000, *Corrosion Resistance of Duplex and 4-6% Mo-Containing Stainless Steels i FGD Scrubber Absorber Slurry Environments*, Presented at Corrosion 2000, Orlando, FL, March 26-31, 2000, NACE International, Houston TX 77218
8. Uhlig, HH, 1948, *Corrosion Handbook*, John Wiley & Sons, New York, NY 10158
9. Van Delinder, LS (Ed), 1984, *Corrosion Basics*, NACE International, Houston, TX 77084

PLANT ITEM MATERIAL SELECTION DATA SHEET

OPERATING CONDITIONS

Material Selection Data Sheets for
The Pretreatment Facility

Materials Selection Data

Component (Name/ID) TLP-COND-00001
System TLP

Operations

Chemicals	Unit	Cold Startup	Normal Operation*	Standby/Idle	Cleaning	Accident
Aluminum	g/l	N/A	8.6E-07	N/A	N/A	N/A
Chloride	g/l		4.8E-07			
Fluoride	g/l		1.1E-08			
Hydroxide	g/l		9.8E-08			
Iron	g/l		7.2E-08			
Nitrate	g/l		9.3E-07			
Nitrite	g/l		1.5E-05			
Phosphate	g/l		4.6E-07			
TOC✝	g/l		7.6E-07			
Sulfate	g/l		1.3E-07			
Undissolved solids	g/l		0.0E+00			
Particle size/hardness	µm (##)		N/A			
Other (Hg)	g/l		9.4E-11			
Carbonate	g/l		2.7E-08			
pH	-		6 to 8			
Dose rate, α, β/γ (inside)	Rad		N/A			
Temperature	°C		5.0E+01			
Velocity	fps		N/A			
Vibration			N/A			
Time of exposure	#		1.0E+02			

* Based on Contract Maximum Chemical A/D run at 60/6

\# - % of total; ## - use Mho scale

Remarks: Stream TLP01

Comments: HNO3 Vapors During Acid Cleaning of Separator and Reboiler

[X] C3 Area

[X] Flushing

✝ List expected organic species: N/A
Use maximum of 2 significant figures

N/A = Information not available or not in Process Engineering Scope.